Monographic lecture - course description

General information

Course name	Monographic lecture
Course ID	13.2-WF-FizP-ML-S17
Faculty	Faculty of Physics and Astronomy
Field of study	Physics
Education profile	academic
Level of studies	First-cycle Erasmus programme
Beginning semester	winter term 2017/2018

Course information

Semester	6
ECTS credits to win	4
Course type	obligatory
Teaching language	english
Author of syllabus	• prof. dr hab. Van Cao Long

Classes forms

The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Lecture	30	2	-	-	Exam

Aim of the course

Student has a thorough knowledge of fundamental concepts of physics for micro world, in particular nuclear physics. He understands conceptionally the spontaneous and stimulated nuclear processes, in particular nuclear fission and fusion which lead to atomic weapons and nuclear power stations. He understands also both of the elementary interactions of nuclear radiation with matter and chemical, biological effects caused by them.

Prerequisites

A thorough knowledge of mathematics and physics at the previous period of first degree study

Scope

course contents:

1. Structure of matter and atomic nuclei
    - Quantum nature of microworld, particle-wave duality
    - Fundamental constituents of matter: quarks and leptons, intermediate bosons as the quanta of the fields representing fundamental interactions, in particular photons as quanta of the electromagnetic field.
    - Model of atoms, level scheme of atomic systems
    - Quantum numbers and the conservation laws related to them
    - Atom in the framework of old quantum theory (Bohr's Model) and Schroedinger's Theory: Atomic shell model and Mendeleev's Periodic Table
    - Hadrons in theory of quarks, in particular protons and neutrons as binding system of quarks
    - Nucleus as a binding system of nucleons (protons and nucleons interacting with gluons which are the quanta of strong-interaction field)
    - Fundamental features of nucleons and atomic nuclei, units in nuclear physics
    - Binding energy
    - Nuclear models: Drop Model, Shell Model and Model of Fermi's Gas
2. Spontaneous processes
    - Exponential Decay Law
    - Decay constant and level width
    - Cross-sections
    - Tunneling effect
    - Alpha, Beta and Gamma decays
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Spontaneous decays of heavy nuclei

3. Stimulated processes: nuclear reactions
    - Reactions with the creation of complex nuclei
    - Reactions with alpha particle
    - Reactions with neutrons
    - Cosmic rays
4. Fission reactions of heavy nuclei
    - Fission of uranium
    - Outline of fission theory
    - Energy of nuclear fission
    - Chain reaction of nuclear fission for uranium and plutonium, critical mass
5. Nuclear weapons
    - Manhattan Project: uranium and plutonium atomic bombs
    - Nuclear fusion and thermonuclear bombs
6. Controlled nuclear reactions. Nuclear energy
    - Different types of nuclear reactors
    - Scheme of nuclear power station
    - Projects in the realization of controlled nuclear fusion
7. Interactions of nuclear radiation with matter
    - Interactions of Alpha particles with matter
    - Interactions of Beta particles with matter
    - Interactions of photons (gamma and X) with matter
8. Elements of Dose Measurements
    - Absorbed dose and units
    - Quality factor Q (or radiation weighting factor R)
    - Equivalent dose and units
9. Chemical and biological effects of nuclear radiation
    - Chemical effects: molecular decay
    - Interaction with living organisms: biochemical and biological effect
    - Linear Hypothesis
    - Risk assessment
    - Radiophobia

Teaching methods

Conventional lecture with the application of multimedia devices.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
Knowledge: Student possesses general knowledge in atomic and nuclear physics, in particular necessary knowledge for understanding fundamental phenomena used for energy production, the phenomena existing in nuclear fission and fusion, He understands also both of the elementary interactions of nuclear radiation with matter and chemical, biological effects caused by them. He is also able to use fundamental mathematical tools in the description of physical phenomena in nuclear physics.		• an exam - oral, descriptive, test and other	• Lecture

Outcome description	Outcome symbols	Methods of verification	The class form
Abilities: Student can analyze and solve physical problems basing on the knowledge and information obtained from the literature, data bases, internet resources in both polish and English, he can perform the analysis of theoretical considerations, and based on this he can formulate proper conclusions. He will able to talk about physical problems by comprehensible and simple language. He could also find himself a necessary knowledge and develop his abilities using different sources of information.		• an exam - oral, descriptive, test and other	• Lecture
Social competences: Student has an awareness about his knowledge and abilities, understand the need and know the possibilities of continuous gain own qualifications (studies of second and third degree, postgraduate studies) – raising the personal, professional and social qualifications. Student understands the role of knowledge popularization in both active and passive side. He possesses the awareness about the importance of professional behavior, caution of ethic principles and respect for variety of views and cultures. Student has the awareness about the responsibility of his work and is ready to respect the rules governing in the team work.		• an exam - oral, descriptive, test and other	• Lecture

Assignment conditions

Passing the written exam.

Recommended reading

[1] B. Dziunikowski, O fizyce i energii jądrowej, Wydawnictwo AGH, Kraków 2001.

[2] Z. Celiński, Energia jądrowa, PWN, Warszawa 1991.

[3] W. N. Cottingham, D. A. Greenwood, An Introduction to Nuclear Physics, Cambridge University Press 2001.

[4] H. A. Enge, Introduction to Nuclear Physics , Addison-Wesley Publishing Company 1972.

Further reading

[1] J. Kubowski, Broń jądrowa, Wydawnictwo Naukowo-Techniczne, Warszawa 2008.

[2] W. Greiner, J. A. Maruhn, Nuclear Models, Springer-Verlag 1996.

Notes

Modified by dr hab. Maria Przybylska, prof. UZ (last modification: 31-07-2018 22:41)